CLAIMS

Claims 1-12 (Canceled)

13. (Previously Presented) A feedback canceller for an audio amplification device comprising:

an adaptive filter comprising means for convolving? an input of the adaptive filter with filter coefficients;

means for combining an output of the adaptive filter with an input of the audio amplification device;

a first band limiting filter having an input coupled to an output of the audio amplification device and an output coupled to the input of the adaptive filter, wherein the first band limiting filter has a passband limited to a frequency band containing unstable frequencies;

a second band limiting filter having an input coupled to the input of the audio amplification device and an output;

a third band limiting filter having an input coupled to the output of the first band limiting filter and an output;

wherein the second and third band limiting filters have passbands limited to the frequency band containing unstable frequencies and the filter coefficients are functions of the outputs of the second and third band limiting filters.

14. (Original) The device of claim 13 wherein the second and third band limiting filters have matching phase responses.

15. (Original) The device of claim 13 wherein the second and third band limiting filters have substantially identical characteristics.

Claims 16-24 (Canceled)

25. (Previously Presented) A method for cancelling feedback in an audio amplification device comprising the steps of:

deriving an open loop transfer function K(f)β(f) of the audio amplification device;

calculating all unstable frequencies fu satisfying the conditions:

$$\begin{aligned} |K(f_u)\cdot\beta(f_u)| &\geq 1 \\ \angle K(f_u)\beta(f_u) &= n\times 360°; \end{aligned}$$

defining an unstable frequency domain containing all f_u bounded at a low cutoff frequency established in accordance with a lowest f_u;

applying an output of the audio amplification device to a first band limiting filter having a passband limited to the unstable frequency domain;

applying an output of the first band limiting filter to an adaptive filter;

combining an output of the adaptive filter with an input of the audio amplification device.

26. (Original) The method of claim 25 wherein the adaptive filter is implemented by a method comprising the steps of:

estimating power of a feedback cancellation error signal and an input signal to the adaptive filter;

adapting filter coefficients in accordance with the estimated power;

removing a DC offset from the adapted filter coefficients;

bandpass filtering the adapted filter coefficients;

applying the adapted filter coefficients to an adjustable filter.

27. (Original) The method of claim 26 wherein the step of removing a DC offset is performed less frequently than the step of adapting filter coefficients.

28. (Original) The method of claim 26 wherein the step of bandpass filtering the adapted filter coefficients is performed only when an adapted filter coefficient exceeds a predetermined threshold.

29. (Original) The method of claim 26 wherein the step of adapting filter coefficients comprises shifting, negation and addition without multiplication.

30. (Original) The method of claim 25 wherein the adaptive filter is implemented by a method comprising the step of convolving the output of the bandpass filter with filter coefficients.

31. (Original) The method of claim 30 wherein the method of implementing the adaptive filter further comprises the step of applying a scaling gain to the filter coefficients.

32. (Original) The method of claim 31 wherein the scaling gain is a power of 2.

33. (Original) The method of claim 32 wherein the scaling gain is in the range of 2^{-3} to 2^{3}.

34. (Original) The method of claim 25 wherein the audio amplification device comprises a hearing aid amplifier.

35. (Original) The method of claim 34 further comprising the step of measuring adaptive filter coefficients with the hearing aid inserted in an ear of a wearer to identify unstable frequencies.

36. (Original) The method of claim 25 wherein the first band limiting filter is a high pass filter.

37. (Previously Presented) The method of claim 36 wherein the passband of the high pass filter has a cutoff frequency approximately 200 Hz below the lowest f_u.

38. (Original) The method of claim 25 further comprising the step of delaying the output of the audio amplification device prior to application to the first band limiting filter.

39. (Original) The method of claim 38 wherein the output of the audio amplification device is delayed by an amount of time that is a function of a feedback path delay.

40. (Original) The method of claim 25 further comprising the step of applying automatic gain control (AGC) to the input of the audio amplification device.

41. (Original) The method of claim 40 wherein AGC is applied after the output of the adaptive filter is combined with the input of the audio amplification device.

42. (Original) The method of claim 40 wherein AGC is applied to both the input of the audio amplification device and the output of the adaptive filter.

43. (Original) The method of claim 25 further comprising the step of adjusting an adaptation speed of the adaptive filter.

44. (Original) The method of claim 43 wherein the adaptation speed is adjusted as a function of a gain of the audio amplification device.

45. (Original) The method of claim 25 further comprising the step of selecting a length of the adaptive filter.

46. (Original) The method of claim 45 wherein the length of the adaptive filter is selected as a function of sampling rate and the frequency band containing unstable frequencies so that duration of the adaptive filter's impulse response is long enough to cover an expected range of variation of group delay in the frequency band containing unstable frequencies in a feedback path from the output of the audio amplification device to the input thereof.

47. (Original) The method of claim 25 further comprising the step of matching a frequency response of the first band limiting filter to a frequency response of a feedback path from the output of the audio amplification device to the input thereof.

48. (Previously Presented) A feedback canceller for a hearing aid amplifier comprising:

means for creating a first delay having an input coupled to an audio output of the hearing aid and an output;

a first band limiting filter having an input coupled to the output of the first delay means and an output;

an adaptive filter having an input coupled to the output of the first band limiting filter and an output;

means for creating a second delay having an input coupled to a conditioned output of a hearing aid microphone and an output;

a first summing node having a non-inverting input coupled to the output of the second delay means, an inverting input coupled to the output of the adaptive filter and an output coupled to an input of a hearing aid processor;

a second band limiting filter having an input coupled to the input of the second delay means and an output;

a second summing node having a non-inverting input coupled to the output of the second band limiting filter, an inverting input coupled to the output of the adaptive filter and an output;

means for selecting a filter coefficient having a first input coupled to the output of the first band limiting filter, a second input coupled to the output of the second summing node and an output for supplying the filter coefficient to the adaptive filter;

wherein the first and second band limiting filters have passbands limited to a frequency band containing all unstable frequencies of the hearing aid amplifier and

wherein a low cutoff frequency of the passbands is established in accordance with a lowest of the unstable frequencies.

49. (Previously Presented) A feedback canceller circuit for a hearing aid amplifier comprising:

means for creating a delay having an input coupled to an audio output of the hearing aid and an output;

a first band limiting filter having an input coupled to the output of the delay means and an output;

an adaptive filter having an input coupled to the output of the first band limiting filter and an output;

a summing node having a non-inverting input coupled to a conditioned output of a hearing aid microphone, an inverting input coupled to the output of the adaptive filter and an output coupled to an input of a hearing aid processor;

a second band limiting filter having an input coupled to the output of the summing node and an output;

a third band limiting filter having an input coupled to the output of the first band limiting filter and an output;

means for selecting a filter coefficient having a first input coupled to the output of the second band limiting filter and a second input coupled to the output of the third band limiting filter and an output for supplying the filter coefficient to the adaptive filter;

wherein the first, second and third band limiting filters have passbands limited to a frequency band containing all unstable frequencies of the hearing aid amplifier and wherein a low cutoff frequency of the passbands is established in accordance with a lowest of the unstable frequencies.

50. (Previously Presented) A feedback canceller circuit for an audio amplification device comprising:

means for creating a delay having an input coupled to an audio output of a hearing aid circuit and an output;

a first band limiting filter having an input coupled to the output of the delay means and an output;

an adaptive filter having an input coupled to the output of the first band limiting filter and an output;

a summing node having a non-inverting input coupled to a conditioned output of a hearing aid microphone, an inverting input coupled to the output of the adaptive filter and an output coupled to the input of the hearing aid processing module;

a second band limiting filter having an input coupled to the output of the summing node and an output;

a third band limiting filter having an input coupled to the output of the first band limiting filter and an output;

means for selecting a filter coefficient having a first input coupled to the output of the second band limiting filter and a second input coupled to the output of the third band limiting filter and an output for supplying the filter coefficient to the adaptive filter;

wherein the first, second and third band limiting filters have passbands limited to a frequency band containing unstable frequencies;

wherein the second and third band limiting filters have matching phase responses.

51. (Previously Presented) The device of claim 50 wherein the second and third band limiting filters have substantially identical characteristics.

Claims 52-53 (Canceled)

54. (Original) The method of claim 25 further comprising the step of storing a plurality of sets of filter coefficients for the first band limiting filter.

55. (Original) The method of claim 54 further comprising the step of selecting a set of filter coefficients as a function of a gain of the audio amplification device.

56. (Original) The method of claim 26 wherein the step of bandpass filtering the adapted filter coefficients applies a passband limited to a frequency band containing unstable frequencies.